# Potato

From Wikipedia, the free encyclopedia

The **potato** is a starchy, tuberous crop from the perennial *Solanum tuberosum* of the Solanaceae family (also known as the nightshades). The word potato may refer to the plant itself as well as the edible tuber. In the region of the Andes, there are some other closely related cultivated potato species. Potatoes were first introduced outside the Andes region four centuries ago, and have become an integral part of much of the world's cuisine. It is the world's fourth-largest food crop, following rice, wheat, and maize.[1] Long-term storage of potatoes requires specialised care in cold warehouses.[2]

**Potato**

Potato cultivars appear in a huge variety of colors, shapes, and sizes

**Scientific classification**

| | |
|---|---|
| Kingdom: | Plantae |
| (unranked): | Angiosperms |
| (unranked): | Eudicots |
| (unranked): | Asterids |
| Order: | Solanales |
| Family: | Solanaceae |
| Genus: | *Solanum* |
| Species: | ***S. tuberosum*** |

**Binomial name**

***Solanum tuberosum***

L.

Wild potato species occur throughout the Americas, from the United States to Uruguay.[3] The potato was originally believed to have been domesticated independently in multiple locations,[4] but later genetic testing of the wide variety of cultivars and wild species proved a single origin for potatoes in the area of present-day southern Peru (from a species in the *Solanum brevicaule* complex), where they were domesticated 7,000–10,000 years ago.[5][6][7] Following centuries of selective breeding, there are now over a thousand different types of potatoes.[6] Of these subspecies, a variety that at one point grew in the Chiloé Archipelago (the potato's south-central Chilean sub-center of origin) left its germplasm on over 99% of the cultivated potatoes worldwide.[8][9]

Following the Spanish conquest of the Inca Empire, the Spanish introduced the potato to Europe in the second half of the 16th century. The staple was subsequently conveyed by European mariners to territories and ports throughout the world. The potato was slow to be adopted by distrustful European farmers, but soon enough it became an important food staple and field crop that played a major role in the European 19th century population boom.[7] However, lack of genetic diversity, due to the very limited number of varieties initially introduced, left the crop vulnerable to disease. In 1845, a plant disease known as late blight, caused by the fungus-like oomycete *Phytophthora infestans*, spread rapidly through the poorer communities of western Ireland, resulting in the crop failures that led to the Great Irish Famine. Thousands of varieties still persist in the Andes however, where over 100 cultivars might be found in a single valley, and a dozen or more might be maintained by a single agricultural household.[10] Besides the need of ensuring proper genetic diversity of a crop, it also underscores the need of depending on several staple crops, and to preferably choose staple crops that are endemic and thus adapted to the local environment.

The annual diet of an average global citizen in the first decade of the 21st century included about 33 kg (73 lb) of potato.[1] However, the local importance of potato is extremely variable and rapidly changing. It remains an essential crop in Europe (especially eastern and central Europe), where per capita production is still the highest in the world, but the most rapid expansion over the past few decades has occurred in southern and eastern Asia. China is now the world's largest potato-producing country, and nearly a third of the world's potatoes are harvested in China and India.[11]

## Contents



# Etymology

The English word *potato* comes from Spanish *patata* (the name used in Spain). The Spanish Royal Academy says the Spanish word is a compound of the Taino *batata* (sweet potato) and the Quechua *papa* (potato).[12] The name potato originally referred to a type of sweet potato rather than the other way around, although there is actually no close relationship between the two plants. The English confused the two plants one for the other. In many of the chronicles detailing agriculture and plants, no distinction is made between the two.[13] The 16th-century English herbalist John Gerard used the terms "bastard potatoes" and "Virginia potatoes" for this species, and referred to sweet potatoes as "common potatoes".[14] Potatoes are occasionally referred to as "Irish potatoes" or "white potatoes" in the United States, to distinguish them from sweet potatoes.[14]

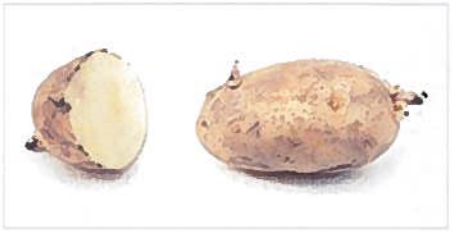
The name **spud** for a small potato comes from the digging of soil (or a hole) prior to the planting of potatoes. The word has an unknown origin and was originally (c. 1440) used as a term for a short knife or dagger, probably related to Dutch *spyd* and/or the Latin "spad-" root meaning "sword"; cf. Spanish "espada", English "spade" and "spadroon". The word spud traces back to the 16th century. It subsequently transferred over to a variety of digging tools. Around 1845 it transferred over to the tuber itself.[15] The origin of "spud" has erroneously been attributed to a 19th century activist group dedicated to keeping the potato out of Britain, calling itself The Society for the Prevention of an Unwholesome Diet.[15] It was Mario Pei's 1949 *The Story of Language* that can be blamed for the false origin. Pei writes, "the potato, for its part, was in disrepute some centuries ago. Some Englishmen who did not fancy potatoes formed a Society for the Prevention of Unwholesome Diet. The initials of the main words in this title gave rise to spud." Like most other pre-20th century acronymic origins, this one is false.[15]

# Characteristics

Potato plants are herbaceous perennials that grow about 60 cm (24 in) high, depending on variety, the culms dying back after flowering. They bear white, pink, red, blue, or purple flowers with yellow stamens. In general, the tubers of varieties with white flowers have white skins, while those of varieties with colored flowers tend to have pinkish skins.[16] Potatoes are cross-pollinated mostly by insects, including bumblebees, which carry pollen from other potato plants, but a substantial amount of self-fertilizing occurs as well. Tubers form in response to decreasing day length, although this tendency has been minimized in commercial varieties.[17]

Flowers of a potato plant

After potato plants flower, some varieties produce small green fruits that resemble green cherry tomatoes, each containing up to 300 true seeds. Potato fruit contains large amounts of the toxic alkaloid solanine and is therefore unsuitable for consumption. All new potato varieties are grown from seeds, also called "true seed" or "botanical seed" to distinguish it from seed tubers. By finely chopping the fruit and soaking it in water, the seeds separate from the flesh by sinking to the bottom after about a day (the remnants of the fruit float). Any potato variety can also be propagated vegetatively by planting tubers, pieces of tubers, cut to include at least one or two eyes, or also by cuttings, a practice used in greenhouses for the production of healthy seed tubers. Some commercial potato varieties do not produce seeds at all (they bear imperfect flowers) and are propagated only from tuber pieces. Confusingly, these tubers or tuber pieces are called "seed potatoes".



Russet potatoes with sprouts

Potato plants

# Genetics

There are about five thousand potato varieties worldwide. Three thousand of them are found in the Andes alone, mainly in Peru, Bolivia, Ecuador, Chile, and Colombia. They belong to eight or nine species, depending on the taxonomic school. Apart from the five thousand cultivated varieties, there are about 200 wild species and subspecies, many of which can be cross-bred with cultivated varieties, which has been done repeatedly to transfer resistances to certain pests and diseases from the gene pool of wild species to the gene pool of cultivated potato species. Genetically modified varieties have met public resistance in the United States and in the European Union.[18][19]

The major species grown worldwide is *Solanum tuberosum* (a tetraploid with 48 chromosomes), and modern varieties of this species are the most widely cultivated. There are also four diploid species (with 24 chromosomes): *S. stenotomum*, *S. phureja*, *S. goniocalyx*, and *S. ajanhuiri*. There are two triploid species (with 36 chromosomes): *S. chaucha* and *S. juzepczukii*. There is one pentaploid cultivated species (with 60 chromosomes): *S. curtilobum*. There are two major subspecies of *Solanum tuberosum*: *andigena*, or Andean; and *tuberosum*, or Chilean.[20] The Andean potato is adapted to the short-day conditions prevalent in the mountainous equatorial and tropical regions where it originated. The Chilean potato, native to the Chiloé Archipelago, is adapted to the long-day conditions prevalent in the higher latitude region of southern Chile.[21]

The International Potato Center, based in Lima, Peru, holds an ISO-accredited collection of potato germplasm.[22] The international Potato Genome Sequencing Consortium announced in 2009 that they had achieved a draft sequence of the potato genome.[23] The potato genome contains 12 chromosomes

and 860 million base pairs making it a medium-sized plant genome.[24] Above 99 percent of all current varieties of potatoes currently grown are direct descendants of a subspecies that once grew in the lowlands of south-central Chile.[25] Nonetheless, genetic testing of the wide variety of cultivars and wild species affirms that all potato subspecies derive from a single origin in the area of present-day southern Peru (from a species in the *Solanum brevicaule* complex).[5][6][7]

Most modern potatoes grown in North America arrived through European settlement and not independently from the South American sources. However, at least one wild potato species, *Solanum fendleri*, is found as far north as Texas and used in breeding for resistance to a nematode species that attacks cultivated potatoes. A secondary center of genetic variability of the potato is Mexico, where important wild species that have been used extensively in modern breeding are found, such as the hexaploid *Solanum demissum*, as a source of resistance to the devastating late blight disease. Another relative native to this region, *Solanum bulbocastanum*, has been used to genetically engineer the potato to resist potato blight.[26]

Potatoes yield abundantly with little effort, and adapt readily to diverse climates as long as the climate is cool and moist enough for the plants to gather sufficient water from the soil to form the starchy tubers. Potatoes do not keep very well in storage and are vulnerable to molds that feed on the stored tubers, quickly turning them rotten. By contrast, grain can be stored for several years without much risk of rotting.[27]

# History

## Peru

The potato originated in the region of southern Peru.[5] Potatoes were first domesticated in Peru between 8000 BC and 5000 BC.[6] In the Altiplano, potatoes provided the principal energy source for the Inca Empire, its predecessors, and its Spanish successor. In Peru above 10,000 feet altitude, tubers exposed to the cold night air turned into chuño; when kept in permanently frozen underground storehouses, chuño can be stored for years with no loss of nutritional value. The Spanish fed chuño to the silver miners who produced vast wealth in the 16th century for the Spanish government.[6]

Potato ceramic from the Moche culture, from the Larco Museum Collection.

## Europe

Sailors returning from Peru to Spain with silver presumably brought maize and potatoes for their own food on the trip. Historians speculate that leftover tubers (and maize) were carried ashore and planted: "We think that the potato arrived some years before the end of the 16th century, by two different ports of entry: the first, logically, in Spain around 1570, and the second via the British isles between 1588 and 1593 ... we find traces of the transport of potatoes travelling from the Canaries to Antwerp in 1567 ... we can say that the potato was introduced there [the Canary islands] from South America around 1562 ... the first written mention of the potato [is] ... a receipt for delivery dated 28 november 1567 between Las Palmas in the Grand Canaries and Antwerp."[28] Basque fishermen from Spain used potatoes as ships' stores for their voyages across the Atlantic in the 16th century, and introduced the tuber to western Ireland, where they landed to dry their cod. In 1553, in the book *Crónica del Peru*, Pedro Cieza de Leon mentions he saw it in Quito, Popayán, and Pasto in 1538. The English privateer Francis Drake, returning from his circumnavigation, or Sir Walter Raleigh's employee Thomas Harriot[29] are commonly credited with introducing potatoes into England. In 1588, botanist Carolus Clusius made a painting of what he called "Papas Peruanorum" from a specimen in the Low Countries; in 1601 he reported that potatoes were in common use in northern Italy for animal fodder and for human consumption.[30]

The Spanish had an empire across Europe, and brought potatoes for their armies. Peasants along the way adopted the crop, which was less often pillaged by marauding armies than above-ground stores of grain. Across most of northern Europe, where open fields prevailed, potatoes were strictly confined to small garden plots because field agriculture was strictly governed by custom that prescribed seasonal rhythms for plowing, sowing, harvesting and grazing animals on fallow and stubble. This meant that potatoes were barred from large-scale cultivation because the rules allowed only grain to be planted in the open fields.[31] In France and Germany government officials and noble landowners promoted the rapid conversion of fallow land into potato fields after 1750. The potato thus became an important staple crop in northern Europe. Famines in the early 1770s contributed to its acceptance, as did government policies in several European countries and climate change during the Little Ice Age, when traditional crops in this region did not produce as reliably as before.[32][33] At times when and where most other crops failed, potatoes could still typically be relied upon to contribute adequately to food supplies during colder years.[34]

In France, at the end of the 16th century, the potato had been introduced to the Franche-Comté, the Vosges of Lorraine and Alsace. By the end of the 18th century it was written in the 1785 edition of *Bon Jardinier*: "There is no vegetable about which so much has been written and so much enthusiasm has been shown ... The poor should be quite content with this foodstuff."[35] It had widely replaced the turnip and rutabaga by the 19th century.[36]

**19th century Europe**

French physician Antoine Parmentier studied the potato intensely and in *Examen chymique des pommes de terres* (Paris, 1774) showed their enormous nutritional value. King Louis XVI and his court eagerly promoted the new crop, with Queen Marie Antoinette even wearing a headdress of potato flowers at a fancy dress ball. The annual potato crop of France soared to 21 million hectoliters in 1815 and 117 million in 1840, allowing a concomitant growth in population while avoiding the Malthusian trap. Although potatoes had become widely familiar in Russia by 1800, they were confined to garden plots until the grain failure in 1838–1839 persuaded peasants and landlords in central and northern Russia to devote their fallow fields to raising potatoes. Potatoes yielded from two to four times more calories per acre than grain did, and eventually came to dominate the food supply in eastern Europe. Boiled or baked potatoes were cheaper than rye bread, just as nutritious, and did not require a gristmill for grinding. On the other hand cash-oriented landlords realized that grain was much easier to ship, store and sell, so both grain and potatoes coexisted.[37]

Antoine Parmentier holding New World plants, François Dumont 1812

Throughout Europe, the most important new food in the 19th century was the potato, which had three major advantages over other foods for the consumer: its lower rate of spoilage, its bulk (which easily satisfied hunger), and its cheapness. The crop slowly spread across Europe, such that, for example, by 1845 it occupied one-third of Irish arable land. [*citation needed*] Potatoes comprised about 10% of the caloric intake of Europeans.[*citation needed*] Along with several other foods that either originated in the Americas or were successfully grown or harvested there, potatoes sustained European populations.[38]

In Britain, the potato promoted economic development by underpinning the Industrial Revolution in the 19th century. It served as a cheap source of calories and nutrients that was easy for urban workers to cultivate on small backyard plots. Potatoes became popular in the north of England, where coal was readily available, so a potato-driven population boom provided ample workers for the new factories. Marxist Friedrich Engels even declared that the potato was the equal of iron for its "historically revolutionary role.[30] The Dutch potato-starch industry grew rapidly in the 19th century, especially under the leadership of entrepreneur Willem Albert Scholten (1819–92).[39]

### Ireland

In Ireland, the expansion of potato cultivation was due entirely to the landless laborers, renting tiny plots from landowners, who were interested only in raising cattle or in producing grain for market. A single acre of potatoes and the milk of a single cow was enough to feed a whole Irish family a monotonous but nutritionally adequate diet for a healthy, vigorous (and desperately poor) rural population. Often even poor families grew enough extra potatoes to feed a pig that they could sell for cash.[40]

A lack of genetic diversity from the low number of varieties left the crop vulnerable to disease. In 1845, a plant disease known as late blight, caused by the fungus-like oomycete *Phytophthora infestans*, spread rapidly through the poorer communities of western Ireland, resulting in the crop failures that led to the Great Irish Famine.[41]

The Lumper potato, widely cultivated in western and southern Ireland before and during the great famine, was bland, wet, and poorly resistant to the potato blight, but yielded large crops and usually provided adequate calories for peasants and laborers. Heavy dependence on this potato led to disaster when the potato blight quickly turned newly harvested potatoes into a putrid mush. The Irish Famine in the western and southern parts of the British-controlled island of Ireland, 1845–49, was a catastrophic failure in the food supply that led to approximately a million deaths from famine and (especially) diseases that attacked weakened bodies, and to massive emigration to Britain, the U.S., Canada and elsewhere.[42] During the famine years roughly one million Irish immigrated, this tide was not turned until the 20th century, when Ireland's population stood at less than half of the pre-famine level of 8 million.

## Africa

It is generally believed that potatoes entered Africa with colonists, who consumed them as a vegetable rather than as a staple starch.[43] Shipping records from 1567 show that the first place outside of Central and South America where potatoes were grown were the Canary Islands.[44] As in other continents, despite its advantages as an anti-famine, high-elevation alternative to grain, potatoes were first resisted by local farmers who believed they were poisonous. Colonialists also promoted them as a low cost food and so it was a symbol of domination. In former European colonies of Africa, potatoes were initially consumed only occasionally, but increased production made them a staple in certain areas. Potatoes tended to become more popular in wartime due to them being able to be stored in the ground. In present day Africa they have become a vegetable or co-staple crop.[43]

### Rwanda

In higher regions of Rwanda, potatoes have become a new staple food crop. Prior to the 1994 Rwandan genocide consumption was as high as 153 to 200 kg per year — higher than in any Western European country. Recently farmers have developed the potato as a cash crop after introducing several new varieties brought back by migrant laborers from Uganda and other varieties from Kenya.[43]

## Asia

The potato diffused widely after 1600, becoming a major food resource in Europe and East Asia. Following its introduction into China toward the end of the Ming dynasty, the potato immediately became a delicacy of the imperial family. After the middle period of the Qianlong reign (1735–96), population increases and a subsequent need to increase grain yields coupled with greater peasant geographic mobility led to the rapid spread of potato cultivation throughout China, and it was acclimated to local natural conditions.

Boomgaard (2003) looks at the adoption of various root and tuber crops in Indonesia throughout the colonial period and examines the chronology and reasons for progressive adoption of foreign crops: sweet potato, Irish potato, bengkuang (yam beans), and cassava.

The potato was introduced in the Philippines during the late 16th century, and to Java and China during the 17th century. It was well established as a crop in India by the late 18th century and in Africa by the mid-20th century.[33]

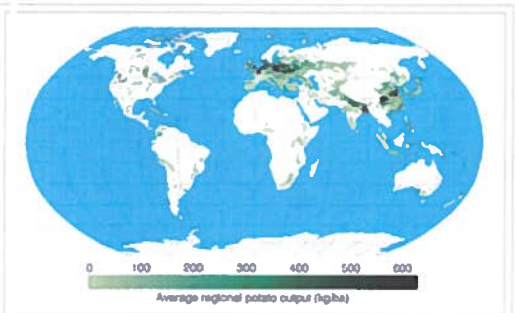
### US and Canada

Potatoes were planted in Idaho as early as 1838; by 1900 the state's production exceeded a million bushels (about 27,000 tonnes[46]). Prior to 1910, the crops were stored in barns or root cellars, but, by the 1920s, potato cellars came into use. U.S. potato production has increased steadily; two-thirds of the crop comes from Idaho, Washington, Oregon, Colorado, and Maine, and potato growers have strengthened their position in both domestic and foreign markets.

Potato harvest in Idaho, circa 1920

By the 1960s, the Canadian Potato Research Centre in Fredericton, New Brunswick, was one of the top six potato research institutes in the world. Established in 1912 as a dominion experimental station, the station began in the 1930s to concentrate on breeding new varieties of disease-resistant potatoes. In the 1950s–1960s, the growth of the French fry industry in New Brunswick led to a focus on developing varieties for the industry. By the 1970s, the station's potato research was broader than ever before, but the station and its research programs had changed, as emphasis was placed on serving industry rather than potato farmers in general. Scientists at the station even began describing their work using engineering language rather than scientific prose.[47] Potatoes are Canada's most important vegetable crop; they are grown commercially in all its provinces, led by Prince Edward Island.[48]

## Role in world food supply




Worldwide potato production

The United Nations FAO reports that the world production of potatoes in 2009 was 330 million tonnes.[49] Just over two thirds of the global production is eaten directly by humans with the rest being fed to animals or used to produce starch. This means that the annual diet of an average global citizen in the first decade of the 21st century included about 33 kg (or 73 lb) of potato.[1] However, the local importance of potato is extremely variable and rapidly changing. It remains an essential crop in Europe (especially eastern and central Europe), where per capita production is still the highest in the world, but the most rapid expansion over the past few decades has occurred in southern and eastern Asia. China is now the world's largest potato-producing country,

**Top Potato Producers**
in *2009*
(million metric tons)

| | |
|---|---|
| People's Republic of China | 73 |
| India | 34 |
| Russia | 31 |
| Ukraine | 20 |
| United States | 20 |
| Germany | 12 |
| Poland | 10 |
| France | 7 |
| Netherlands | 7 |
| Belarus | 7 |
| **World Total** | **330** |

and nearly a third of the world's potatoes are harvested in China and India.[11] The geographic shift of potato production has been away from wealthier countries toward lower-income areas of the world, although the degree of this trend is ambiguous.[50]

*Source:*
*UN Food & Agriculture Organisation (FAO)[3] (http://faostat.fao.org/site/340/default.aspx)*

In 2008, several international organizations highlighted the potato's role in world food production, in the face of developing economic problems. They cited its potential derived from its status as a cheap and plentiful crop that grows in a wide variety of climates and locales.[51] Due to perishability, only about 5% of the world's potato crop is traded internationally; its minimal presence in world financial markets contributed to its stable pricing during the 2007–2008 world food price crisis.[52][53] Thus, the United Nations officially declared 2008 as the *International Year of the Potato*,[54] to raise its profile in developing nations, calling the crop a "hidden treasure".[55] This followed the International Rice Year in 2004.

# Nutrition

The potato contains vitamins and minerals, as well as an assortment of phytochemicals, such as carotenoids and natural phenols. Chlorogenic acid constitutes up to 90% of the potato tuber natural phenols. Others found in potatoes are 4-O-caffeoylquinic acid (crypto-chlorogenic acid), 5-O-caffeoylquinic (neo-chlorogenic acid), 3,4-dicaffeoylquinic and 3,5-dicaffeoylquinic acids.[56] A medium-size 150 g (5.3 oz) potato with the skin provides 27 mg of vitamin C (45% of the Daily Value (DV)), 620 mg of potassium (18% of DV), 0.2 mg vitamin $B_6$ (10% of DV) and trace amounts of thiamin, riboflavin, folate, niacin, magnesium, phosphorus, iron, and zinc. The fiber content of a potato with skin (2 g) is equivalent to that of many whole grain breads, pastas, and cereals.

**Potato, raw, with skin**

| Nutritional value per 100 g (3.5 oz) | |
|---|---|
| **Energy** | 321 kJ (77 kcal) |
| **Carbohydrates** | 19 g |
| **- Starch** | 15 g |
| **- Dietary fiber** | 2.2 g |
| **Fat** | 0.1 g |
| **Protein** | 2 g |
| **Water** | 75 g |
| Thiamine (vit. $B_1$) | 0.08 mg (7%) |
| Riboflavin (vit. $B_2$) | 0.03 mg (3%) |
| Niacin (vit. $B_3$) | 1.1 mg (7%) |
| Vitamin $B_6$ | 0.25 mg (19%) |
| Vitamin C | 20 mg (24%) |
| Calcium | 12 mg (1%) |
| Iron | 1.8 mg (14%) |
| Magnesium | 23 mg (6%) |
| Phosphorus | 57 mg (8%) |
| Potassium | 421 mg (9%) |
| Sodium | 6 mg (0%) |

Percentages are relative to US recommendations for adults.

In terms of nutrition, the potato is best known for its carbohydrate content (approximately 26 grams in a medium potato). The predominant form of this carbohydrate is starch. A small but significant portion of this starch is resistant to digestion by enzymes in the stomach and small intestine, and so reaches the large intestine essentially intact. This resistant starch is considered to have similar physiological effects and health benefits as fiber: It provides bulk, offers protection against colon cancer, improves glucose tolerance and insulin sensitivity, lowers plasma cholesterol and triglyceride concentrations, increases satiety, and possibly even reduces fat storage.[57][58][59] The amount of resistant starch in potatoes depends much on preparation methods. Cooking and then cooling potatoes significantly increases resistant starch. For example, cooked potato starch contains about 7% resistant starch, which increases to about 13% upon cooling.[60]

The cooking method used can significantly impact the nutrient availability of the potato.